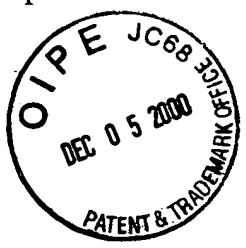
38492 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of :
:
S. Joseph Campanella : Group Art Unit: 2731
:
Serial No.: 09/640,686 :
:
Filed: August 18, 2000 :
:
For: Method and Apparatus for Mobile Platform Reception and Synchronization in Direct Digital Satellite Broadcast System :



REQUEST FOR RETENTION OF DISCLOSURE DOCUMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Reference is made to the following Disclosure Document which contains subject matter related to that disclosed and claimed in the present application:

Number:	453253
Title:	Transmission Synchornization Correction for Distance Between Terrestrial Stations in Satellite Reinforcement System
Date of Deposit:	March 19, 1999

In view of the filing of the present application, it is requested that the Disclosure Document identified above be designated for permanent retention. A copy of the Disclosure Document is attached for reference purposes.

Respectfully submitted,

Stacey J. Longanecker
Reg. No. 33,952

Roylance, Abrams, Berdo & Goodman, L.L.P.
1300 19th Street N.W., Suite 600
Washington, D.C. 20036
(202) 659-9076

Dated: 5 December 2000

WORLDSPACE CORPORATION

DISCLOSURE DOCUMENT NO.

453253

FILING FEE: $10.00
RETAINED FOR 2 YEARS
THIS IS NOT A PATENT APPLICATION

PTO-1652 (4/96)

Disclosure Expires Mar. 19, 2001

OIPE JC50 MAR 19 1999 PATENT & TRADEMARK OFFICE

OIPE JC68 DEC 05 2000 PATENT & TRADEMARK OFFICE

March 19, 1999

JEH/SJC

Doc'd Att File 38392
Rec'd
APR 7 1999
ROYLANCE, ABRAMS BERDO & GOODMAN L.L.P.
BY

38392

Commissioner of Patents and Trademarks
Washington, D.C. 20231

Re: Submission of Disclosure Document for "Transmission Synchronization Correction for Distance Between Terrestrial Stations in Satellite Reinforcement System"

Dear Sir:

The undersigned, Dr. S. Joseph Campanella, assignor to WorldSpace Corporation, is the inventor of the disclosed invention entitled "Transmission Synchronization Correction for Distance Between Terrestrial Stations in Satellite Reinforcement System". The undersigned requests that the attached papers be accepted under the Disclosure Document Program, and that they be preserved for a period of two (2) years.

A check in the amount of $10.00 is attached to cover the required fee. Also attached is a duplicate copy of this document and a stamped, pre-addressed envelope for use by the U.S. Patent and Trademark Office in acknowledging receipt of this document.

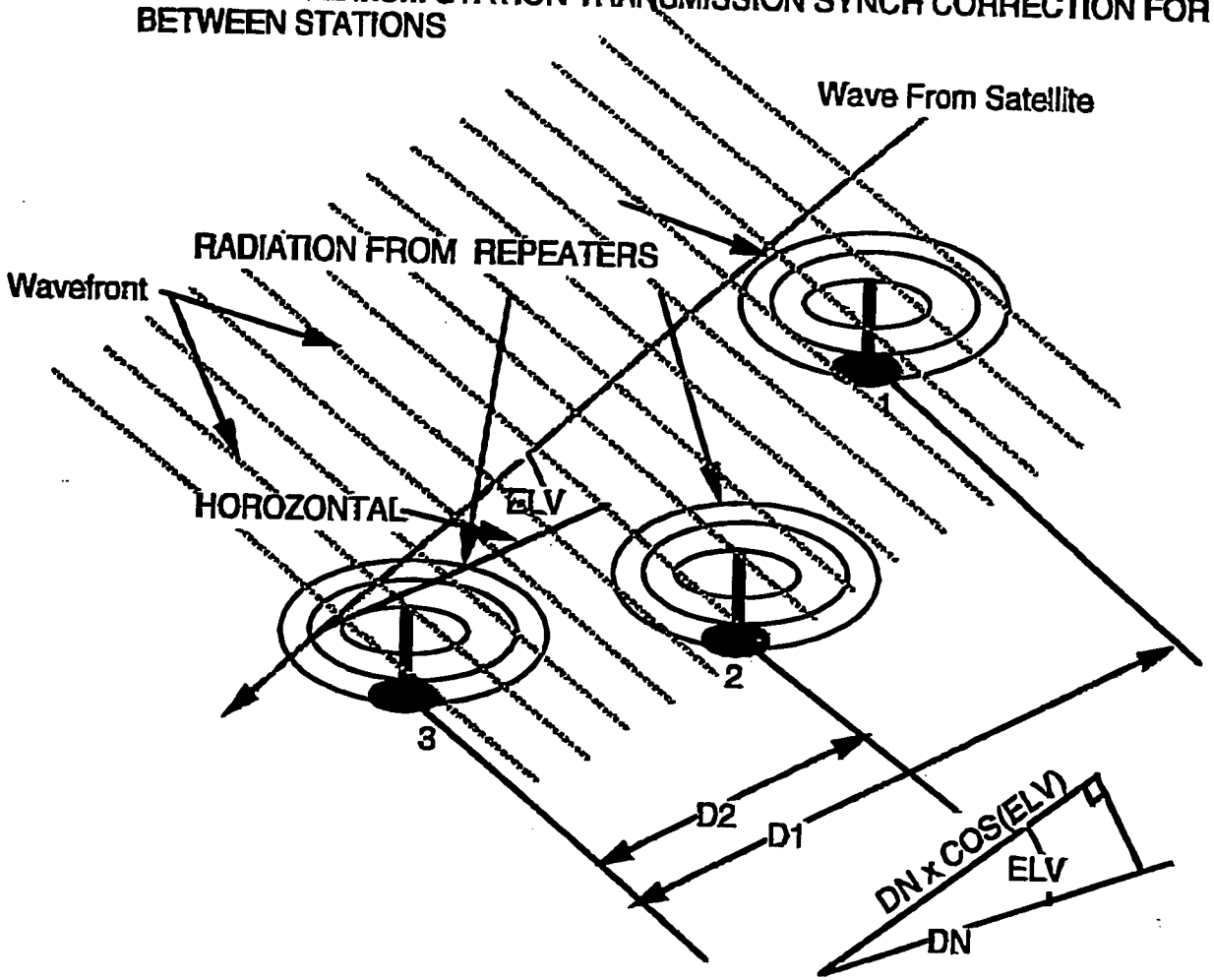
Please send the acknowledgement of filing, and any other correspondence relating to this disclosure document, to counsel for WorldSpace Corporation at the following address: John E. Holmes, Roylance, Abrams, Berdo & Goodman, L.L.P., 1225 Connecticut Avenue, N.W., Suite 315, Washington, D.C. 20036.

Respectfully submitted,

Dr. S. Joseph Campanella

2400 N Street, NW Washington, D.C. 20037 USA Tel: 202 969 6000 Fax: 202 969 6001 www.worldspace.com

TERRESTRIAL MCM STATION TRANSMISSION SYNCH CORRECTION FOR DISTANCE BETWEEN STATIONS



DN = DISTANCE OF TERRESTRIAL STATION N TO THE FARTHEREST STATION FROM THE SATELLITE WITHIN THE NETWORK COVERAGE. THIS DISTANCE IS MEASURED PARALLEL TO THE PROJECTION OF THE LINE-OF-SIGHT ON TO THE HORIZONTAL PLANE AND PERPENDICULAR TO THE WAVEFRONT. IN THE CASE SHOWN ABOVE THE FARTHEREST STATION IS # 3.

ELV = ELEVATION ANGLE TO THE SATELLITE OBSERVED FROM THE STATIONS OF THE NETWORK. NOTE THAT EACH STATION WILL HAVE A SLIGHTLY DIFFERENT ELEVATION ANGLE, BUT IN A TYPICAL REINFORCEMENT NETWORK THE DIFFERENCES ARE SO SMALL AS TO BE INSIGNIFICANT. HENCE, THE ELEVATION ANGLES CAN ALL BE ASSUMED TO BE EQUAL.

BASED ON THE ABOVE ASSUMPTIONS, THE SYNC. TIME CORRECTION, TN, FOR STATION N WILL BE:

TN = {DN x COS(ELV)} / c , WHERE c = SPEED OF LIGHT.

S.J. CAMPANELLA 03 /18 /99

DESCRIPTION

This disclosure pertains to a time correction that must be applied to the signal emitted from each terrestrial reinforcement transmitter when the latter emitted signal is a replay of a signal distributed to all such terrestrial reinforcement stations from a common geostationary or non-geostationary satellite source.

To understand the need for such time correction, realize that the signals retransmitted from the terrestrial stations must all have a common instant of synchronization for their individual transmissions. Typically, for a terrestrial reinforcement network, all retransmissions of the reinforcement signals must be synchronized to occur within 1 microsecond of one another for terrestrial reinforcement network comprising typically from a few stations to as many as thirty and even more to operate most efficiently. This is true for any terrestrial reinforcement waveform such as ones using MCM, OFDM, CDMA, FDMA, Adaptive TDM or frequency hopping.

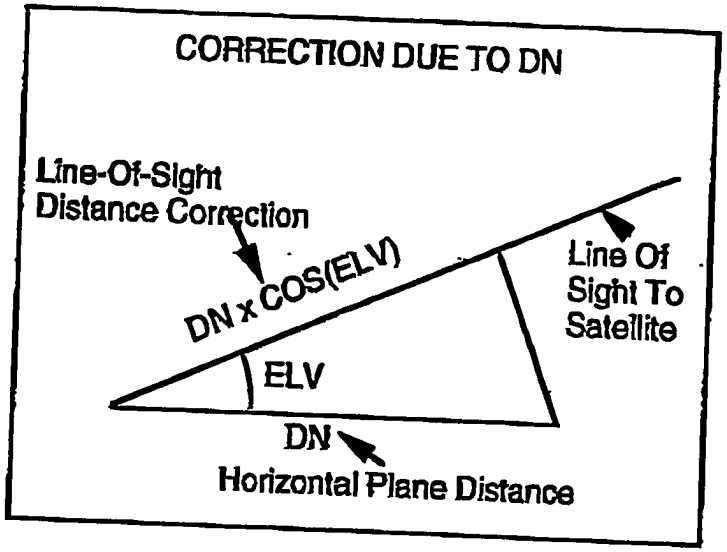
The problem arrises because the signal arriving from the common satellite source travels over different distances to the various terrestrial reinforcement stations. These differences in the satellite to terrestrial reinforcement station distances if not corrected will appear as synchronizationtime differences among terrestrial signals and will seriously degrade or destroy the effectivness of the terrestrrial reinforcement network.

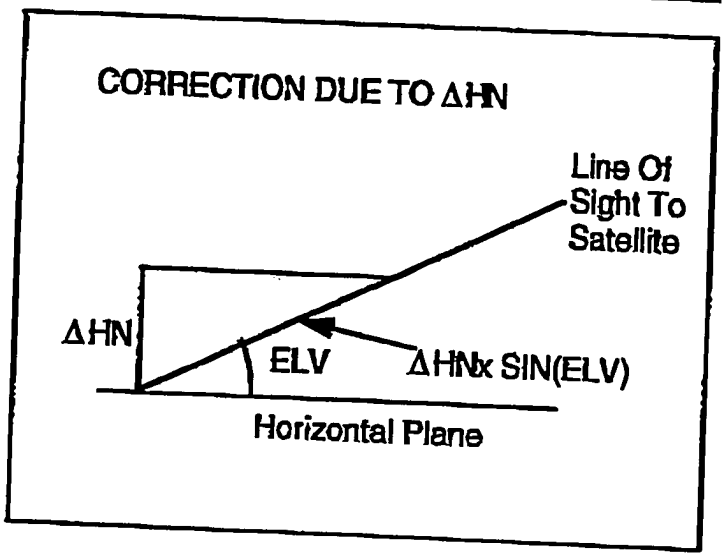
To correct the situation, a time delay of a precise magnitude determined by the elevation angle to the satellite and the distance differential to a particular terrestrial timing reference station (as identified below) must be injected into the repeated signal path. The terrestrial timing reference station should be that one of the network which is at the greatest distance from the satellite. Consequently, to synchronize any other station, it is necessary to know that station's distance DN to the terrestrial timing reference station along a line lying in the the horizontal plane of the earth, parallel to the direction of wave arrival and normal to the wavefront. Alsothe difference ΔHN in the height between the reference station and station N can have an influence on the timing correction.

Based on the knowledge of DN, ΔHN, and ELV, and using the Geometry shown below, the time correction is given by

$$TN = \{DN \times \cos(ELV) + \Delta HN \times \sin(ELV)\}/c$$

To illustrate the magnitude of the effect, consider a case where DN = 10 km, ELV = 35°, ΔHN = 0 m, and c = 10^8 m/s, then ΔTN = 27.5μs. This magnitude of time difference is too great to remain uncorrected and must be compensated for by inserting a delay of 27.5 μs in the transmission of the reinforcement signal from station N. delaying the If ΔHN = 30 m then an additional delay of .0574 μs. The latter is negligable. Only if a station is located on a very high mountain will the height difference be of concern.


CORRECTION DUE TO DN
Line-Of-Sight
Distance Correction
DN x COS(ELV)
Line Of
Sight To
Satellite
ELV
DN
Horizontal Plane Distance


CORRECTION DUE TO ΔHN
Line Of
Sight To
Satellite
ΔHN
ELV
ΔHN x SIN(ELV)
Horizontal Plane

Alignment of TDM frame symbol phase with the MCM Frame Symbol.

In MCM transport, a set of the TDM frame symbols is supplied to an IFFT which assigns the set of TDM symbols to a set of MCM carriers in an MCM symbol. For optimum operation of the MCM network, the same TDM symbols of the set needs to be carried in the same sub carriers of each MCM symbol emitted in the terrestrial network. Otherwise, there is no way for constructive recovery at a receiver to be accomplished among the multiplicity MCM symbol arrivals coming from the various terrestrial stations.

A reinforcement network will typically comprise from 10 to 30 terrestrial reinforcement stations located in selected geographic locations to cover a metropolitan area. Due to propagation delay differences from the satellite to the individual reinforcement terrestrial stations, the alignment of the TDM waveform symbols to the MCM symbols among them can be vary over a range as great as 138μs or 280 TDM symbols for a 40 km spread.

Even if all MCM symbol frames are precisely synchronized to the same time instant across all stations of the network, there will be misalignments of the TDM symbols with the MCM symbols ranging over various values up to a maximum (as cited in the example above) depending on the accidents of spacing and the azimuth and elevation angles of each station to the satellite.

This means that the ensemble of MCM symbols arriving at a receiver will not contain the same TDM symbols in each of the MCM symbol carriers. Literally, the TDM symbols will be jumbled up and the ability to constructively combine them seriously impaired.

By use of the alignment method described by the inventor, the TDM symbols can be appropriately aligned with the MCM symbols to eliminate the problem.

PATENT

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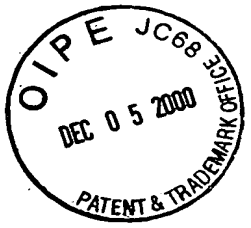

Attention: Box Missing Parts

COMPLETION OF APPLICATION UNDER 37 C.F.R. § 1.53

Commissioner for Patents
Washington, D.C. 20231

Sir:

In response to the Communication dated October 5, 2000, copy attached, submitted herewith are:

☒ An executed Declaration and Power of Attorney.

☒ Filing fee, $710, surcharge $130, and assignment recording fee $40.

☒ An assignment of the invention to WorldSpace Management Corporation

☒ Two Requests for Retention of Disclosure Document.

☐ Please charge Deposit Account No. 18-2220 in the amount of $_____. A duplicate copy of this sheet is attached.

☒ A check in the amount of **$880** is attached.

☒ The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 18-2220. A duplicate copy of this sheet is attached.

- ☒ Any additional patent application filing fees under 37 C.F.R. § 1.16.
- ☒ Any additional patent application processing fees under 37 C.F.R. § 1.17.

Stacey J. Longanecker
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Dated: 5 December 2000